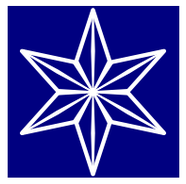
Talk given at ESO@50, Garching, 2012, S Feltzing

Micro-lensed dwarf stars in the Galactic Bulge

Sofia Feltzing
Lund Observatory



Collaborators: Daniel Adén (Lund), Martin Asplund (MPA), Thomas Bensby (Lund), Avishay Gal-Yam, Andy Gold (Ohio), Jennifer Johnson (Ohio), Sara Lucatello (Padoa), Jorge Melendez (Sao Paolo), Jennifer Yee (Ohio)

Why dwarf stars?

- Very little, if any, changes in the composition of the atmosphere over time
- Spectra are “easy” to analyse
- For stars close to the turn-off, ages can be determined
- Large samples of dwarf stars in the solar neighbourhood to compare with

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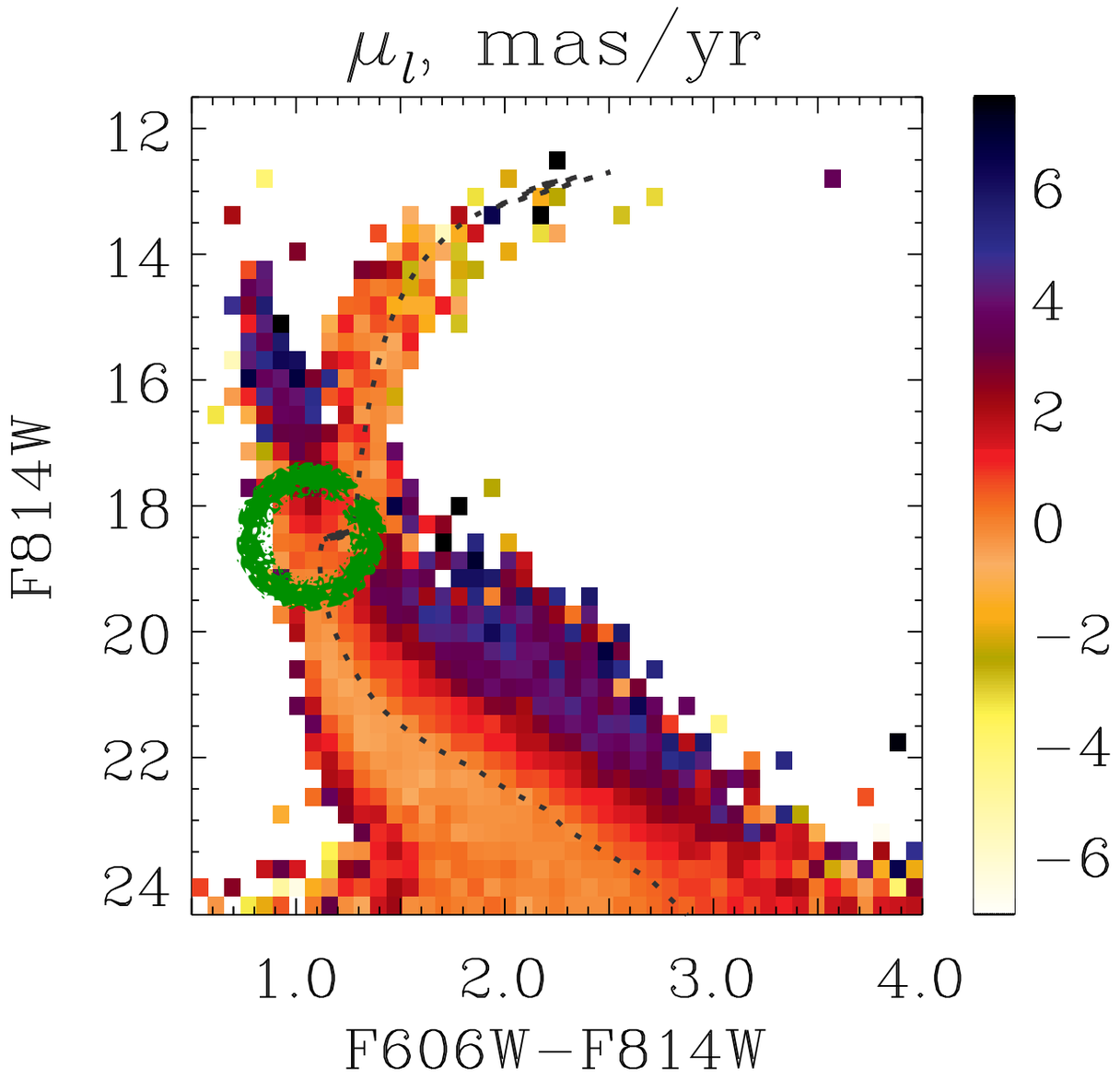
But …bulge dwarfs are faint



V_{TO} ~19-20

Clarkson et al. (2008 ApJ 684 1110)

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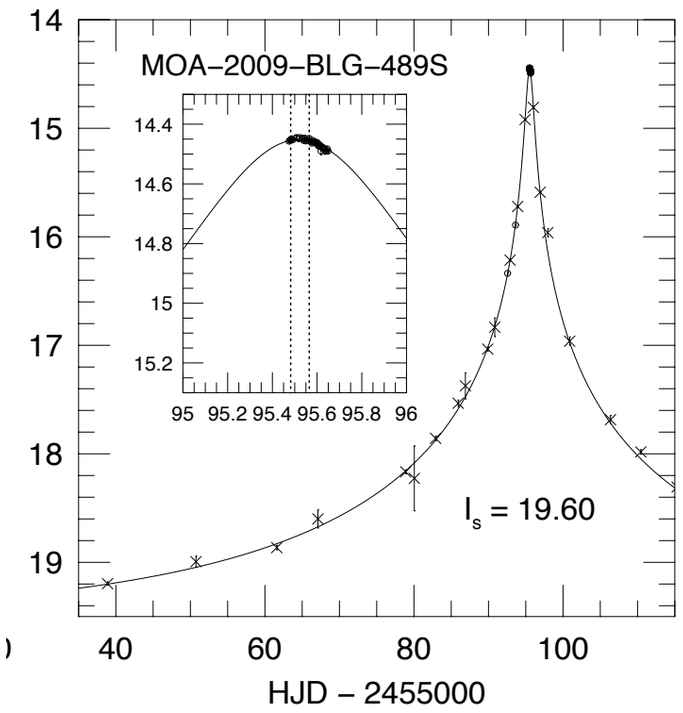
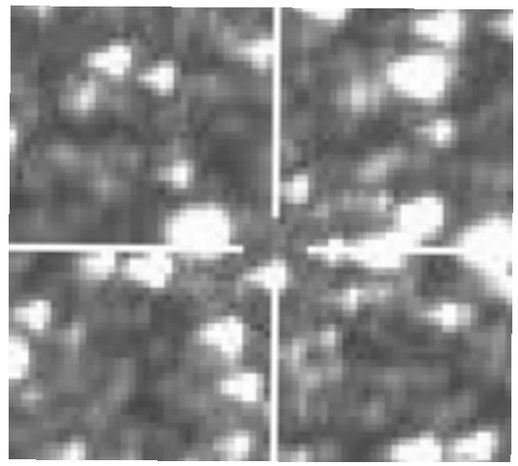
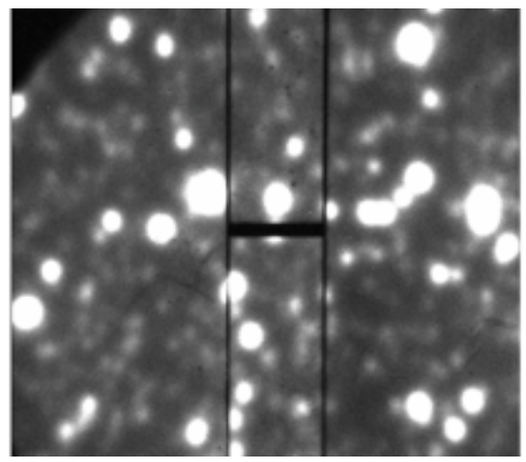
Micro-lensing to the rescue



- Transient phenomena
- Target-of-Opportunity program on UT2/VLT (P82 – P90; PI: SF)
- $20 \leq A_{max} \leq 1000$
- 54 microlensed dwarfs observed, 47 with VLT

An event





http://ogle.astrouw.edu.pl/
http://www.phys.canterbury.ac.nz/moa/

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Results

Based on data from the following papers:

- Bensby et al. (2012, in prep.)
- Bensby et al. (2011 A&A 533 A134)
- Bensby et al. (2010 A&A 521 L57)
- Bensby et al. (2010 A&A 512 A41)
- Epstein et al. (2010 ApJ 209 447)
- Bensby et al. (2009 ApJ 699 L174)
- Bensby et al. (2009 A&A 499 737)
- Cohen et al. (2008 ApJ 682 1029)
- Johnson et al. (2008 ApJ 685 508)
- Johnson et al. (2007 ApJ 655 L33)

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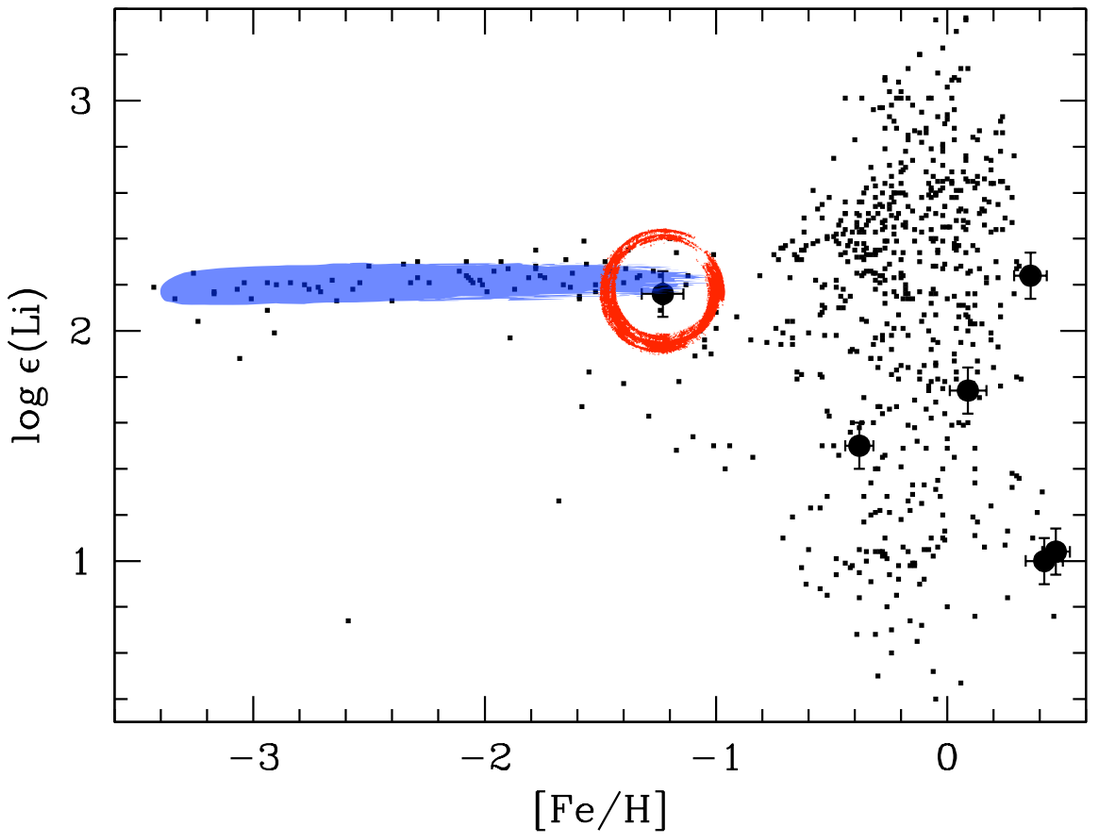
Li in the Bulge

Spite plateau



- First clear detection of Li in the bulge
- Metal-poor part of the bulge follows the Spite plateau

Bensby et al. (2010 A&A 521 L57)

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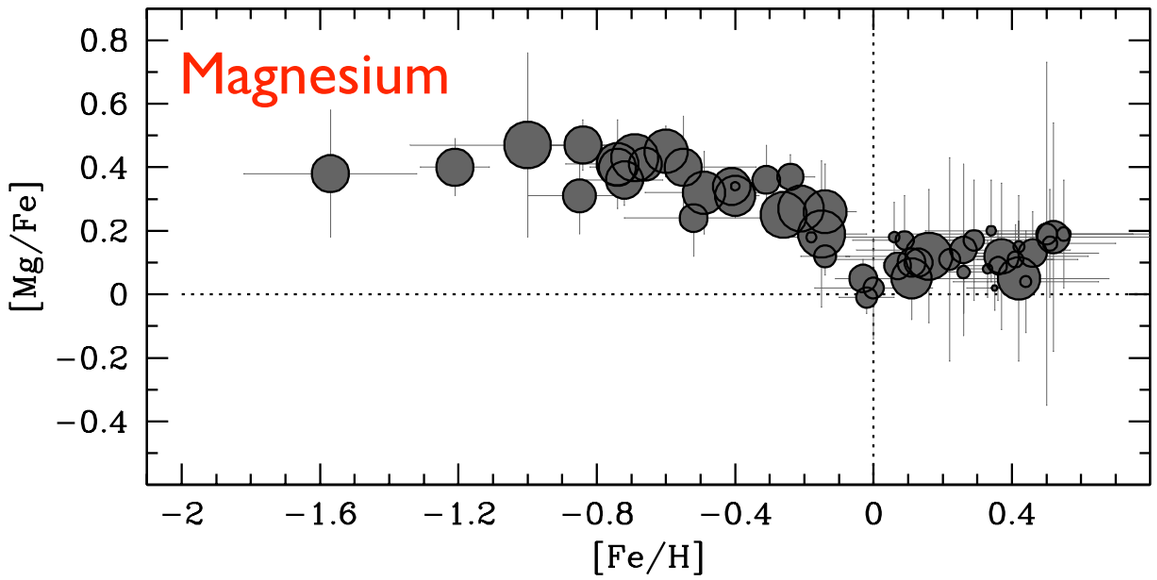
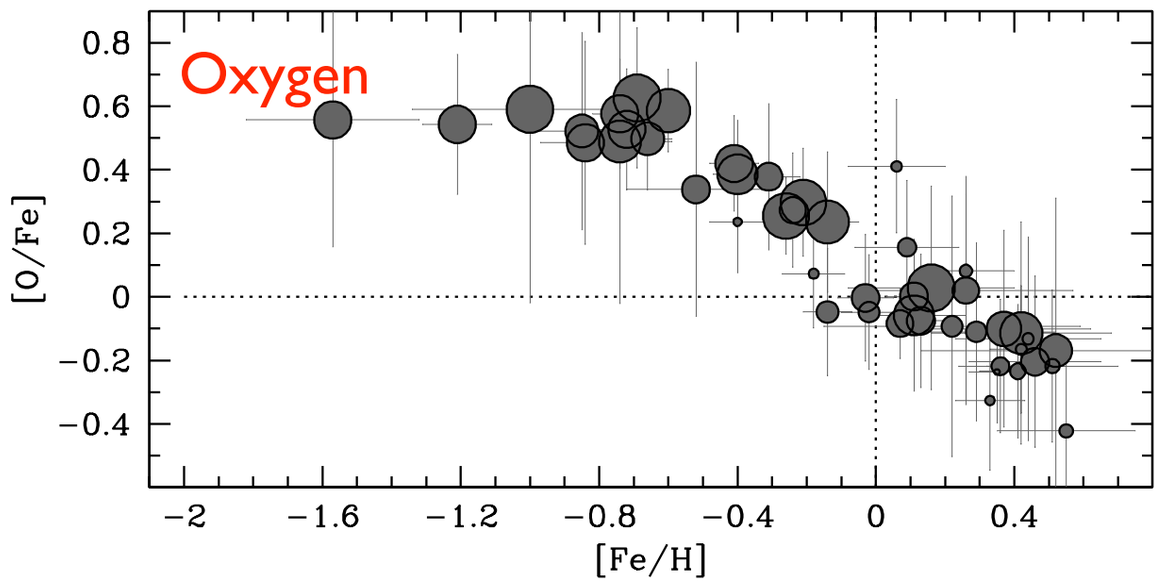
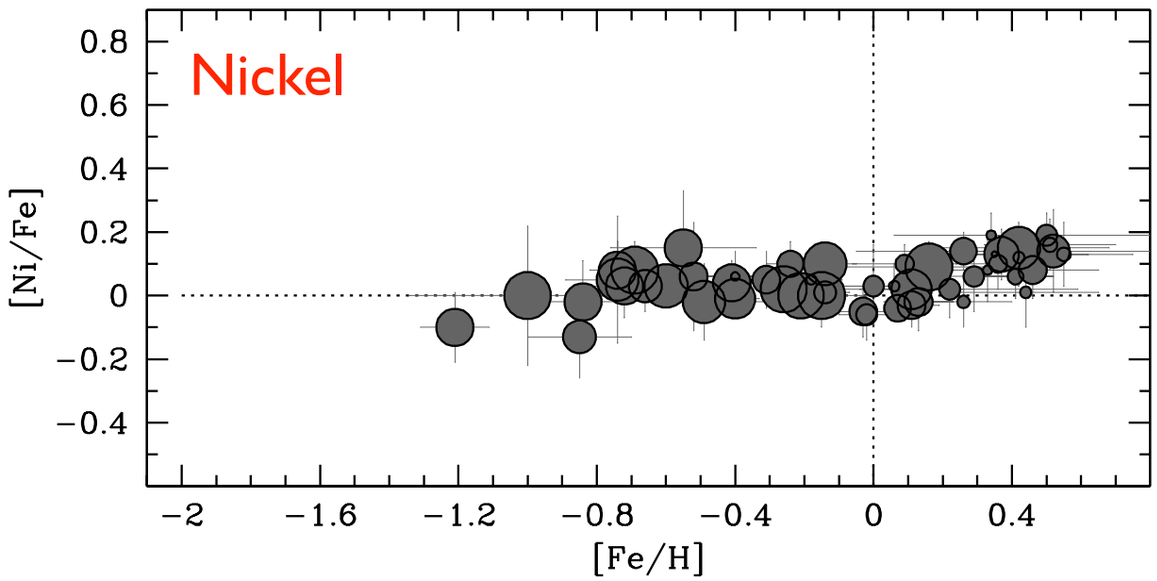
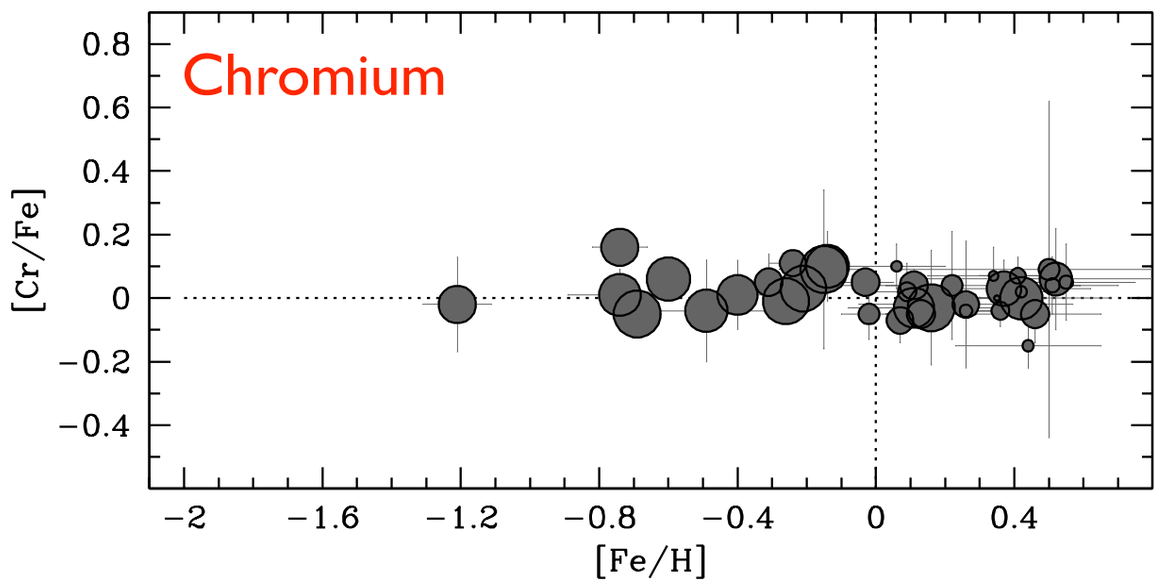
Abundance trends









Size = Age

Bensby et al. (2012, in prep)

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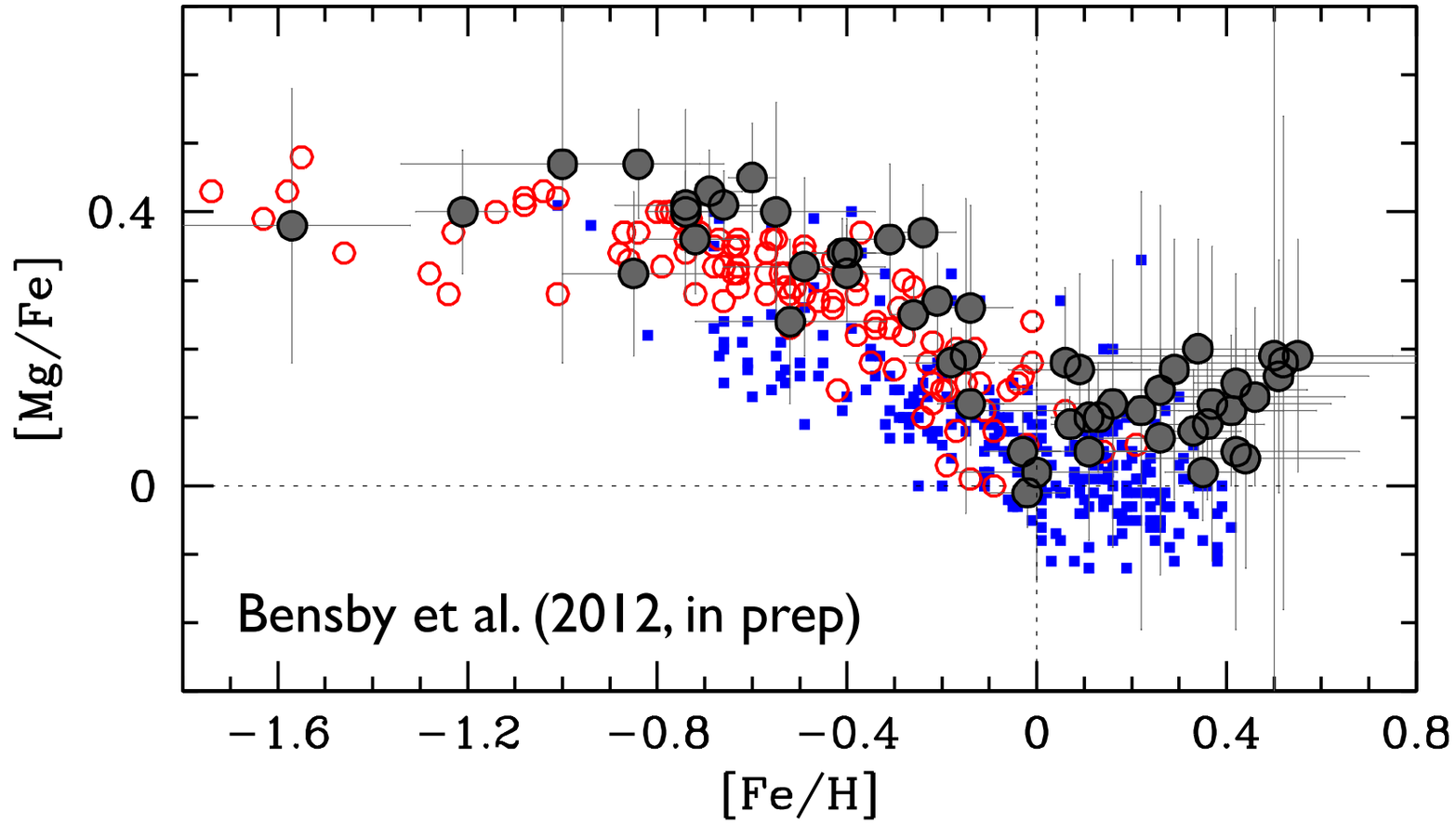
Abundance trends

700 disk dwarf stars near the Sun
Kinematic thick disk
54 dwarf stars in the bulge Kinematic thin disk



- Large span in [Fe/H]; follows the thick disk trend

Melendez et al. (2008 A&A 484 L21), Alves-Brito et al. (2010 A&A 513 A35),
Gonzalez et al. (2011 A&A 530 A54)

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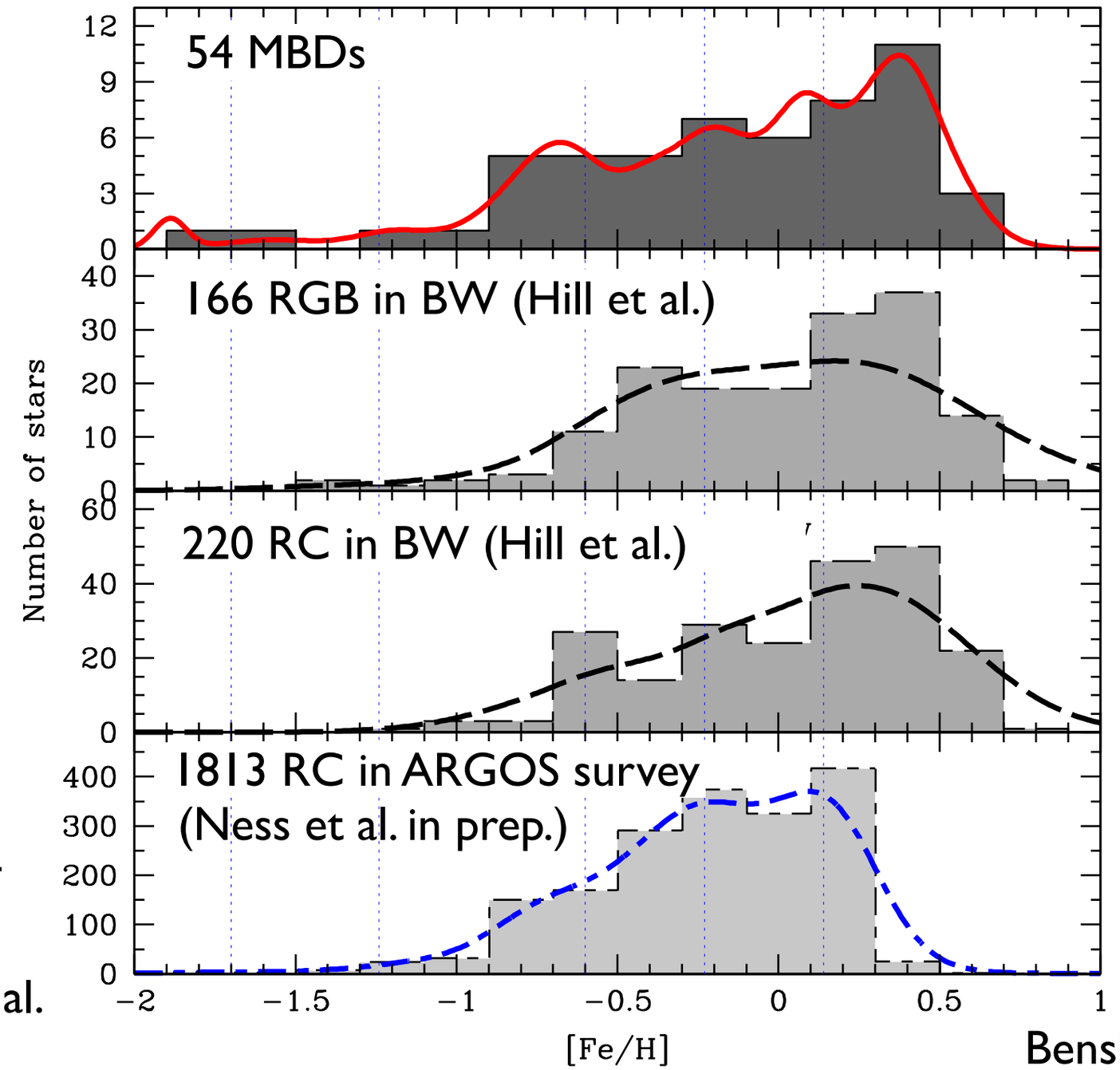
Bulge MDFs

Early results indicated
$MDF_{dwarfs} \neq MDF_{giants}$

Generalised MDFs



l ~ +7° to –6°
b ~ –1° to –5°

(l,b) = (1°,–4°)

l = +5°, 0°, –5°
b = –5°

x-positions of
5 Gaussians
from Ness et al.

Bensby et al. (2012, in prep)

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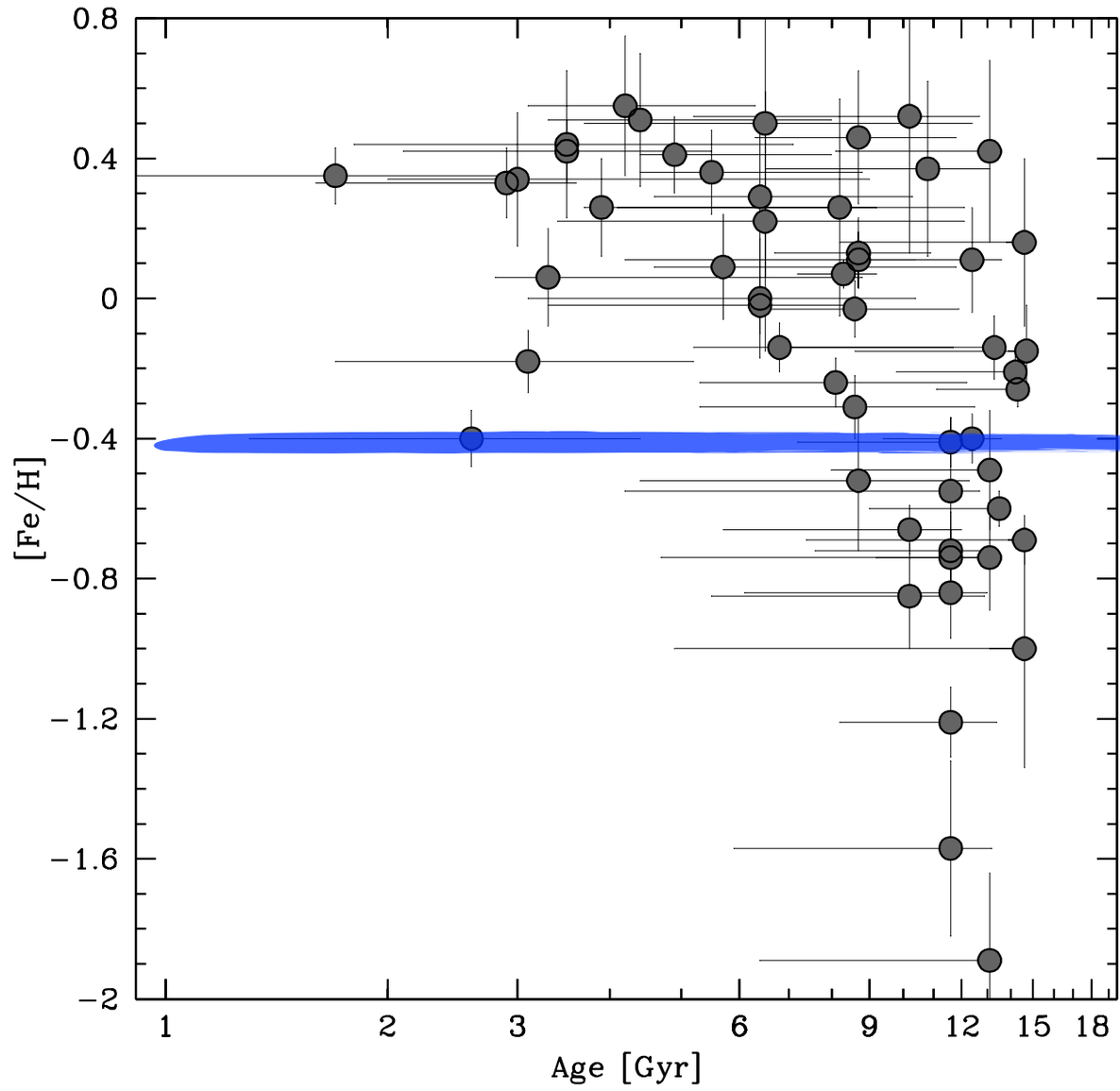
Ages



Large spread

All old

Nataf & Gould (2012 ApJL 751 L39)
Lind et al. (2011 A&A 527 A148)

Bensby et al. (2012, in prep)

Summary

- Micro-lensed dwarf stars have proved a fruitful tool for studying the Galactic Bulge
- Elemental abundance trends are very tight with no broad [α/Fe] spread as in the S.N.
- No high abundances at large [Fe/H], consistent with most recent RGB/RC studies
- There are not only old stars in the bulge but also younger stars. Consistent with van Loon et al. 2003, Cole & Weinberg 2002, Uttenthaler et al. 2007.

van Loon et al. 2003 MNRAS 338 857
Cole & Weinberg 2002 ApJ 574 L43
Uttenthaler et al. 2007 A&A 463 251

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What remains?

- Age – metallicity plot needs better statistics for conclusive results
- Given that α-elements are somewhat enhanced relative to the thick disk trends an exploration of timescales using *r*/*s*-ratios would be worthwhile
- Amax – [Fe/H] correlation remains unexplained

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A few extra slides

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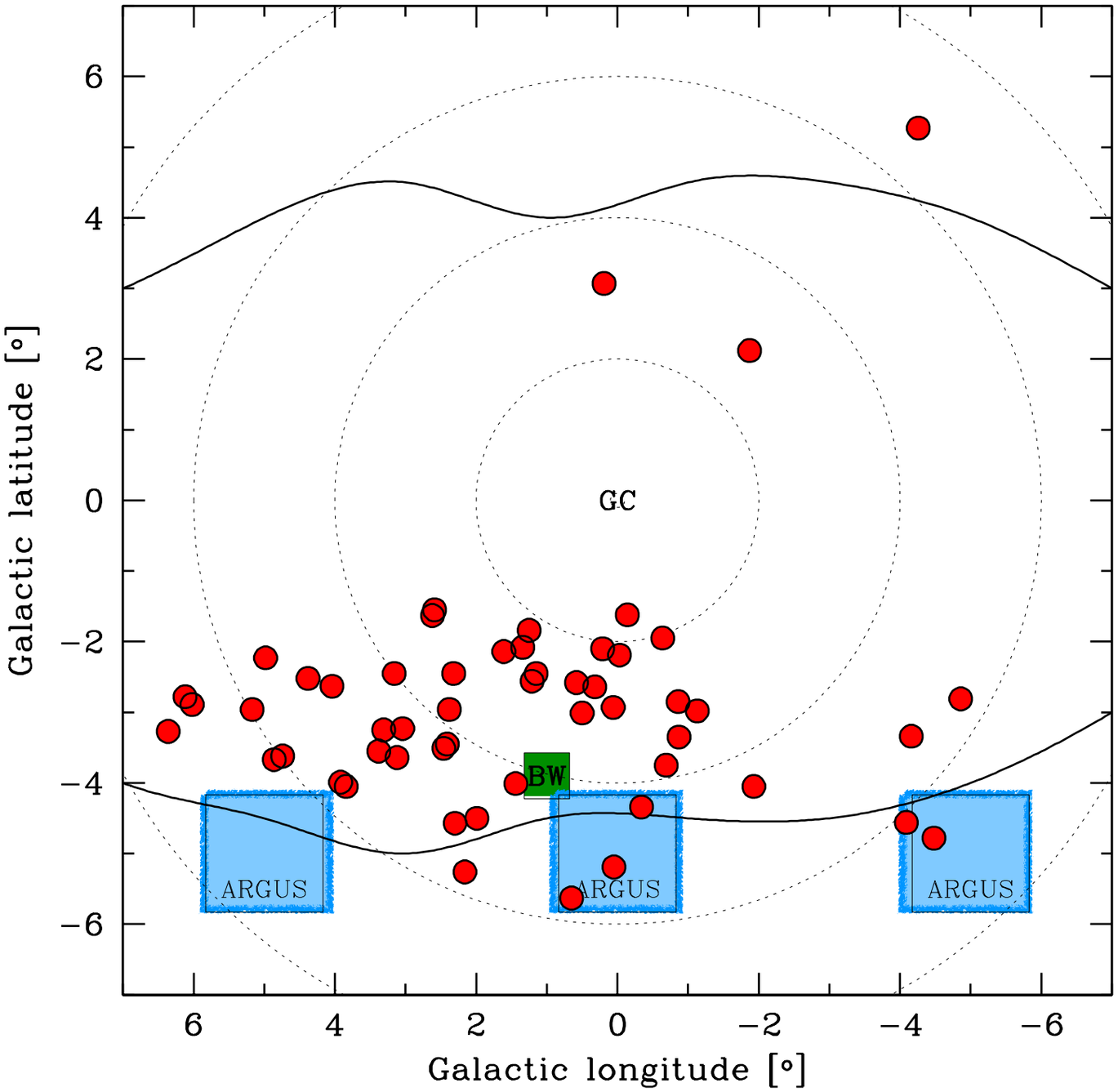
Where?



54 micro-lensed dwarf and subgiant stars
Baade's window
Innermost three fields of AAOmega survey (Ness et al.)

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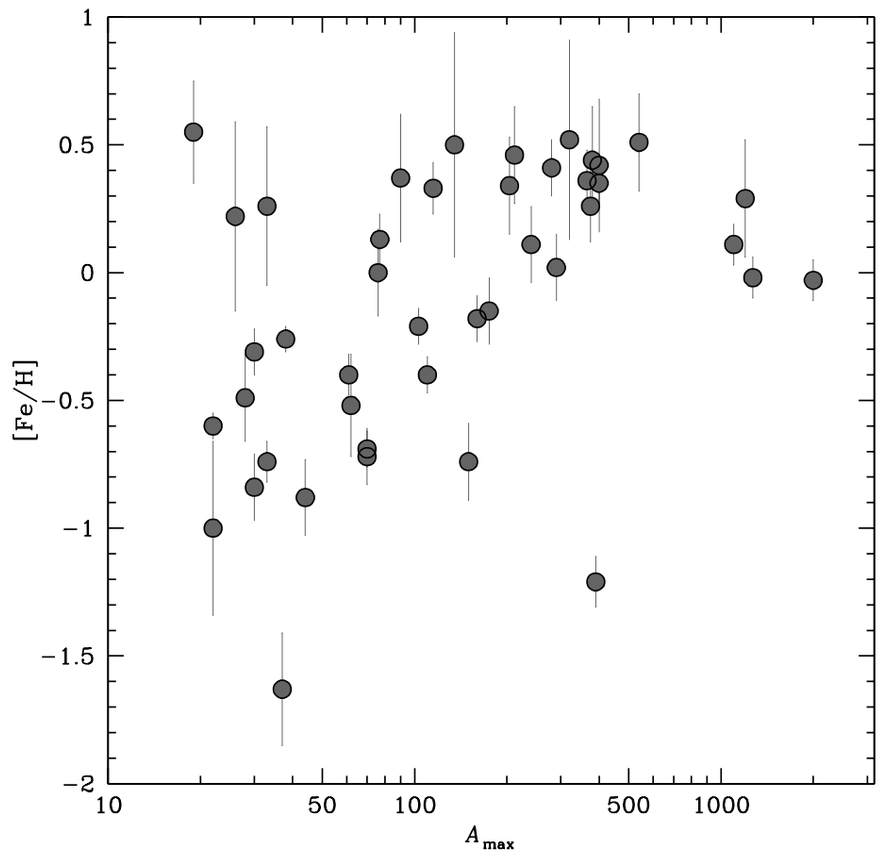
[Fe/H] – A_{max}



The correlation between Amax and [Fe/H] appears to slowly go away as the sample is built up. See also Cohen et al. (2010 ApJ 711 L48)

Bensby et al. (2012, in prep)